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Here we are brought face to face with the question: How far is it really worth while to go in the establishment of the formula? The geodesist contents himself with the determination of at most two constants for the figure of the earth. No one, to my knowledge, has succeeded in establishing a formula which represents the actual shape of the earth and exhibits at least the most marked of the earth's manifest irregularities of surface. Professor Love, I believe, has established a formula representing the irregularities of the first, second and third degrees, but has not deemed it worth while to go beyond this extent. And so it would appear to me that the time has come to halt in the establishment of a complex formula involving forty-eight unknowns or more which at the very best can give but an inadequate representation of the actual facts of the earth's magnetism. It would seem more logical to stop with a certain finite number of terms involving a limited number of unknowns which represent, from a physical standpoint, the chief and principal facts of the magnetic condition of the earth. The magnetization resulting from this limited expression we should call our "normal field," or "field of references" as the geodesist calls his adopted figure, the *spheroid of reference*. The residuals from this field of reference would then receive separate or special treatment in accordance with their extent and their character. In conclusion an application of this mode of treatment to the United States was shown (Slide 6).

L. A. BAUER

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SCIENTIFIC BOOKS

Revision of the Pelycosauria of North America. By E. C. CASE. Publication No. 55 of the Carnegie Institution, Washington, July, 1907.

This important monograph deals with the most remarkable group of the Permian verte-

brata. The Pelycosauria, popularly known as "fin-back lizards," have been known hitherto only from brief and scattered descriptions principally by the late Professor Cope, mostly based upon very incomplete material. Dr. Case's studies of the last few years, aided by a grant from the Carnegie Institution, have done a great deal towards clearing up our understanding of the structure and relationships of the order. In the present memoir he has brought together all the earlier descriptions, and has redescribed and fully illustrated all the better-known types from the more complete material now available.

The rich and varied vertebrate fauna of the Permian beds of northern Texas and the adjacent parts of Oklahoma was first made known to science by Cope in 1878 and succeeding years. The collections upon which his earlier descriptions were based were obtained for him by Jacob Boll and J. C. Isaac in 1878-80, and by Professor W. F. Cummins, the well-known Texas geologist, in 1881-4. In 1895-7 Professor Cope's collections were greatly increased by the energy of the indefatigable collector, Charles H. Sternberg. All these collections are now in the American Museum of Natural History, along with additional material since obtained by Mr. Sternberg and Dr. Case. Dr. Case has also made considerable collections for the University of Chicago, and the Paleontological Museum of Munich has acquired a large and valuable collection through the exertions of Mr. Sternberg. So far as the reviewer is aware, there are no important collections of vertebrates from the Texas Permian, except in the three institutions named. The preparation of the specimens for study or exhibition is exceptionally difficult and tedious, since the bones are usually encased in a hard flinty concretion which can be removed only by laborious and painstaking chipping. The progress of our knowledge of this wonderful fauna is greatly hindered by this difficulty in preparation.

The vertebrate fauna of the Texas Permian consists chiefly of armored amphibians (Stegocephalia), large and small, and primitive reptiles of several groups. Its prime interest lies in the fact of its great antiquity.

The Permian is the oldest fauna of land vertebrates of which we have any extensive knowledge, illustrates the early stages in the adaptation of the vertebrate phylum to terrestrial locomotion and shows us what the early land vertebrates were like from which the various orders of reptiles and mammals are more or less directly descended. It is from the study of the reptiles and amphibia of this period that we shall obtain the best evidence regarding the relationship of the several orders of reptiles and the origin of the mammals.

The typical Pelycosauria are better described as archaic rather than primitive, since, while for the most part remarkably primitive reptiles, they are in certain respects highly specialized. This is especially seen in the enormously elongated neural spines of the vertebræ, which form a high rigid bony fin on the back, and in the differentiation of the dentition by enlargement of certain teeth to serve as canine teeth, as in carnivorous mammals. This specialization of the dentition is correlated with great changes in the form of the skull and the proportions of its bones, and the development of the back fin; with reduction of the tail and adaptation of the feet and limbs to more truly terrestrial locomotion.

The two best-known genera are *Dimetrodon* and *Naosaurus*. In the first the spines are very long, slender and simple; in the other they are not quite so long, but stouter, and provided with a series of short cross-bars like the yards of a full-rigged ship. *Dimetrodon* is known from the complete skeleton; in *Naosaurus* the proper correlation of the skull is in doubt. These animals were of fairly large size, six to eight feet in length, massively proportioned, the head high, compressed, nearly a foot long in the largest species of *Dimetrodon*, with fin spines over three feet long. Dr. Case considers that the spines must have been connected by a web of tough horny skin, but were probably not covered by flesh. No satisfactory explanation of the use of this fin has been given; the author regards it as illustrating Beecher's law of the exuberance of spines and bony outgrowths in the

last stages of evolution of a race. These genera are the extreme stages in the specialization of the pelycosaurs. They are connected by a series of intermediate forms with small aquatic unspecialized types related to *Protorosaurus*, *Palæohatteria* and other primitive reptiles of the Permian of Europe.

The inclusion of the early stages of the Pelycosaur phylum in the order Pelycosauria is, in the reviewer's opinion, open to some objection. These small primitive genera are structurally ancestral to the typical Pelycosaurs (they are not genetically so, as Dr. Case is careful to point out, since so far as we know they are all contemporaneous), but that is no reason for including them in the order. An order, genus or species is defined by certain facts of common structural peculiarities indicative of descent from a common ancestor and by certain acquired specializations indicative of similar adaptation. The ancestor is a member of the phylum, but not necessarily of the order; it may belong to a more primitive order which has given rise to one or more specialized orders of a later epoch. Unless we hold to this view of their limits it becomes impossible to properly define natural groups. In the opinion of the reviewer the Pelycosauria could be more satisfactorily defined if these primitive genera were left out, to be placed perhaps in the Protorosauria, from which the Pelycosauria would be, structurally speaking, derivable.

The author confirms the views previously expressed by himself and by Osborn as to the general relationship of the order. They belong to the primitive Diapsidan or Rhynchocephaloid group of the Reptilia (super-order Diaptosauria Osborn), *Sphenodon* being the nearest modern relative. Their relationship to the Cotylosauria is more remote than supposed by Cope, and the inclusion of both groups in an order Theromora is inadmissible. Substantially the same views are expressed in recent contributions to the classification of the reptilia by Broom¹ and by Boulenger² as

¹ "Classification of the Theriodonts and their Allies," Rep. S. Afr. Assoc. Adv. Sci., 1903.

² "On the Characters and Affinities of the Triassic Reptile *Telerpeton elginense*," Proc. Zool. Soc. London, 1904, p. 470.

to the position of the Pelycosauria. Broili, however, in his recent memoir upon Permian Stegocephalia and Reptilia of Texas³ and elsewhere⁴ is inclined to hold to the classification of Cope and include them with the Cotylosaurs and Anomodontia in the Theromorpha (Tharomora) as quite nearly related primitive groups.

Dr. Case has shown a praiseworthy conservation in the manufacture of new species, and the tabular and descriptive differentiation of the families, genera and species full and clear. The quality of the illustration varies widely—some of the drawings are excellent—most of the photographic work is poor. The sketch restorations of the better-known genera assist greatly in making the subject clearer. The type revision leaves somewhat to be desired as to method and clearness; it would have been an aid to systematists if the author had differentiated his "types" more clearly, according to the excellent nomenclature given by Schuchert.⁵ Some of Dr. Case's "types" are holotypes, others neotypes; "co-type" means sometimes paratype, sometimes neotype, never "co-type" in the generally accepted sense of the word. Many of the original types (holotypes and paratypes) are indeterminate, or unidentifiable, and the species are either indeterminate or rest upon neotypes, but this should have been clearly stated in each case. Lack of clearness in this subject is liable to mislead systematists and compilers who might suppose it necessary to make changes in nomenclature. The reviewer, in preparing a catalogue of the types in the Cope collection, has not found this necessary.⁶

³ *Palæontographica*, Bd. LI., 1904.

⁴ "Stammreptilien," *Anatom. Anz.*, Jena, 1904, Bd. XXV., p. 577.

⁵ SCIENCE, 1897, p. 636; "Catalogue of Type Specimens in the National Museum," Bull. U. S. Nat. Mus., No. 53, part 1, preface.

⁶ *E. g.*, Case refers *Sphenacodon* Marsh to *Dimetrodon* Cope, which it antedates; and *Clepsyrops limbatus* to *Dimetrodon incisions*, a later described species. If definitely referable, this would invalidate both the genus *Dimetrodon* and the species *incisions*. But the older genus and

Altogether the memoir is a very valuable and useful contribution, and a great step forward in our knowledge of the Permian Vertebrata. As the author premises, we are by no means yet in a position to revise and describe the Pelycosauria in any final and conclusive manner. Nevertheless, his conclusions in regard to the position and relationship of the order are not likely to be very radically altered by future discoveries. It is to be hoped that the remaining groups of Permian vertebrata will be similarly studied and monographed in the near future.

Accurate stratigraphic work is also very much needed in this field. Little is known of it except through the reports of Professor Cummins in the Texas Survey, which, on account of limited time and means and the extensive field to be covered, are of a preliminary and general character and have not been satisfactorily correlated with the paleontological work and with stratigraphic work in adjoining regions. Dr. Case has recently published⁷ some preliminary data for more exact stratigraphic work, and Dr. I. C. White in his studies upon invertebrata⁸ and Dr. Broili upon the vertebrata⁹ have published some valuable stratigraphic observations upon the typical region. Dr. Geo. I. Adams¹⁰ has also made a preliminary correlation with the work of Taff¹¹ and Gould¹² in Oklahoma. But much more remains to be done before we can arrive at any adequate understanding of the faunal levels in the formation and the evolution of the various phyla during the period.

W. D. MATTHEW

Mental Pathology and Normal Psychology.

By GUSTAV STÖRRING. Translated by THOMAS LOVEDAY. Pp. 298. Swan Sonnenschein and Co. 1908.

In spite of the very general and increasing species are in fact regarded as indeterminate and should have been so placed in the synonymy.

⁷ *Bull. A. M. N. H.*, 1907.

⁸ *Amer. Nat.*, 1889.

⁹ *Palæontographica*, 1904, Bd. LI.

¹⁰ *Bull. Geol. Soc. Am.*, 1903, 191.

¹¹ U. S. G. S., Professional Paper No. 31, 1904.

¹² U. S. G. S., Water Supply and Irrigation Paper No. 148, 1905.